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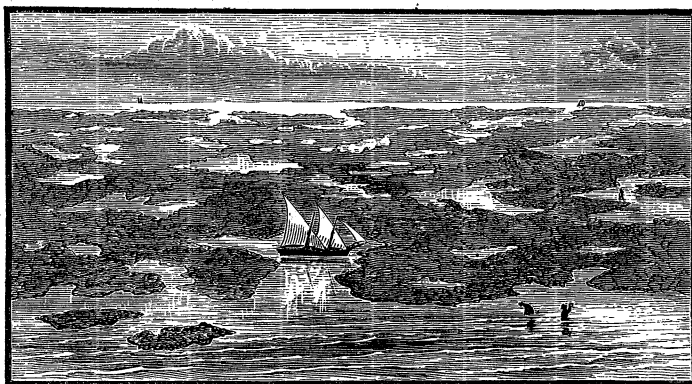
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enough of the river to eat away any considerable portion of the shale underneath; and third, if it did both of these impracticabilities, how the subterranean stream could break down the face of the fall faster than the water could carry off the fragments and maintain the face of the precipice perpendicular. We do not desire, however, to deprive either the guides or the oldest inhabitants of their time-honored privilege of astonishing the public, but they should remember and take warning from the fate of the "reliable contraband;" they may, even as he did, lose their hold upon the credulity of the public.

THE CRUISE OF THE "ABROLHOS."

BY C. FRED. HARTT.



RECIFE DO LIXO, ABROLHOS, AT LOW TIDE.

AFTER one has travelled up and down the Brazilian coast and become familiar with the long sea-beaches, bordered with ridges or domes of sand, that almost uninterruptedly stretch from the Amazonas to Cape Frio, and with the ever-thundering Atlantic surf that draws its foamy line around those lonely shores, it seems strange to see at Caravellas a

coast scarcely elevated above the water, and a beach washed by a sea as quiet as an inland lake. The water here along shore is very shallow, owing to the very gentle slope of the bottom, and not only for that reason is it quiet, but because very extensive reefs, lying between the main-land and the islands of the Abrolhos, break the force of the waves, and protect the coast.

I hired at Caravellas, for the exploration of the Abrolhos region, a little launch, the *Abrolhos*, and three men, the captain being a Dane, who for many years had followed the life of a fisherman among the Abrolhos reefs, and, as it will hereafter be seen, knows them perfectly.

It was a glorious morning early in last September, the month that closes the Brazilian winter, that we embarked. Up went the long, narrow, triangular sails to the short masts, Jacó blew from his big horn a few cornet-like notes, that went breaking with strange echoes through the cocoa-palm groves on the river bank below the town, and we dropped down stream. Next day, for we had been delayed at the mouth of the river, we were beating by dawnlight out of the entrance. After sticking fast on a sand-bank or two, we soon stood off towards the islands. Near the shore the water was very turbid and reddish; but leaving the land it soon became clearer, and the yellowish tint gave way to green. The sounding-line showed a depth of about sixteen metres, with a white sandy bottom, which gave to the sea a whitish appearance. There was not a cloud in the sky, and the low sun looked warmly down on the waves rippling under the last breath of the dying land-breeze.

About seven miles from the land I observed that the water ahead was spotted by dark brownish patches of color, irregular in outline, and resembling the shadows cast by little clouds. Occasionally one might mark the breaking of a wave over one of these patches. "These are the *Chapeirões*,"* said Jacó. This is the name given in Brazil to

* Pronounced *Shāpayróēngs*. The singular is "Chapeirão," pronounced *Shāpayrówng*.

isolated coral structures, which are very common on the Brazilian reef-grounds. Corals grow over the bottom in small patches, and without spreading much, rise often to a height of forty to fifty or more feet, like towers, and sometimes attain the level of low tide. At the top they are usually very irregular, and sometimes spread out like mushroom, or, as the fishermen say, umbrellas. Some of these Chapeirões are only a few feet in diameter. Two Chapeirões are seen in the foreground of the engraving of the Recife do Lixo. Professor Verrill tells me that similar structures occur also in the West Indies. We soon came up to one and passed almost over it. They were of all heights, and on the larger the waves were breaking. The sea was full of them, a perfect labyrinth, through which our skilful captain readily tacked his way. In some places a good-sized ship might sail among them, but it would not be safe to venture among them in dark or stormy weather. As we threaded our way through, Jacó and the sailors told me stories of the whale and other fisheries carried on here, of their adventures while engaged in their hardy pursuits in these waters, and how vessels sometimes ran on the Chapeirões, sticking fast by the middle of the keel, to the amazement of the captain, who found deep water all round, the vessel being perched, as it were, like a weather-cock on the top of a tower. Occasionally, I am told, the shock is sufficient to break off and upset some of the slender ones, for they are not very compact.

After a while we came out once more into open water. The reef-ground we had crossed is known as the Parêdes, or *walls*. From north to south it is fifteen to twenty miles in length, while its width varies from three to nine miles. Where we crossed it, nearly in the middle, there are only Chapeirões; but farther north, as well as farther south, there are extensive reefs laid bare at low tide over an area of many square miles; but these I did not visit until my return voyage.

On finishing my examination of the islands, of which I

have already given a description in my last article, I set out on the evening of the 12th of September to visit the northernmost reef of the Parêdes, called the *Recife do Lixo*. My plan was to cross the reef that night at high tide, and anchor in a sac or little bay on the western side, so as to profit by the low tide of the full moon of the morrow. Eastward of the islands a few miles, with a length of about nine to ten miles, and a breadth in some places of four miles, is an area over which Chapeirões grow very abundantly, forming obstructions on which many a vessel has been wrecked. They unite nowhere to form a large reef, and are rarely anywhere uncovered at low tide.

Ordinarily, vessels and steamships go outside of these reefs to the eastward, in sight of the islands. It is not easy, however, to calculate one's distance from a point at sea, and especially from a light by night, and many vessels, notwithstanding the light-house, have been wrecked upon them. West of the islands there is deep water, there are no Chapeirões, and between the islands and the Parêdes there is a channel about eight miles in width, with plenty of water and no obstructions. The safest way is to pass to the westward of the islands, when one may run close in shore, so long as the course is north or south. There is then no danger whatever, and there is a smoother sea. On the return voyage from Rio, the American steamship "South America" was, at the suggestion of the writer, taken through this channel.

Varying winds drove the launch "Abrolhos" into the region of the Chapeirões to the north-eastward of the islands. Jacó and I took turns in heaving the lead. Among the Chapeirões we found a depth of sixteen to twenty metres, and once, while becalmed, we found twenty metres alongside one Chapeirão, and three metres on top. Waiting for the wind, the hooks were used, and we soon had, floundering about below among my boxes of corals, some fine *Guaroupas*. By and by the wind freshened and we set out to cross the channel, sounding all the way, finding a depth of seven-

teen to twenty-nine metres, a bottom composed of sand and shells, and no impediment to navigation. The almost full moon made the night wellnigh as light as day.

Late at night I turned in below, and, with the sound of waves outside and the wash of the bilge-water and the occasional floundering of the not yet dead fish inside, dreamed of home, while Jacó and the men ever and anon heaved the lead, calling out the number of metres. At last the voice of a sailor was heard at the hatch, "*O Seu Carlos! O recife!*" The reef! I went hastily on deck in the moonlight. Splash went the lead. "*Dous metros,*"—only two metres of water. We are on the reef. I rolled myself in my great coat and stretched myself out on the deck listening to the splash of the lead, and gazing at the big cumulus clouds, lit up by the moon, and memory carried me back to long rides along the sea-beaches farther south, to many a bivouac under the clear dewy sky, when the slow march of the tardily gliding hours was marked by the sinking of the moon among the waving, glistening, giant fronds of the cocoa-palm, or by the Southern Cross, that, like a great hour-hand, swung round the southern pole, and with the monstrous *modinha* of the steersman I fell asleep.

"*Dez metros!*" cries Jacó, "O Carlos! we are in the channel." The great reef of the Parêdes is deeply indented, according to fishermen, by two very irregular channels, which, entering it from the north, almost separate it into three parts, very much as the island of Cape Breton is cut up by the Bras d'Or. We had crossed the outer reef and reached the eastern channel, which is very narrow. In this way, with the sounding-line in hand, we crossed the reef, and anchored just on the inner side to wait for the morning.

The sun rose and Jacó wound his horn. Here we were just off the reef and alongside the sac for which we had steered. As the tide went down, the reef began to uncover itself, and became dry over a very large area, as far north and south as we could see from the deck of our little vessel.

As soon as the falling tide had sufficiently defined our little harbor, we sailed in, and anchored close to the reef. I took a basket with cans and bottles, and leaped on the reef, taking with me two men with a *taraffa*, a kind of round casting net, to take fish in the pools.

The reef, exposed at low tide, was level on top, and the corals, as at the Abrolhos, were generally dead and covered by barnacles, etc. It was exceedingly irregular and rugged in outline, and deeply indented by little bays. On the surface were many large pools (see sketch), in which I found beautiful specimens of *Millepora alcicornis*, *Siderastræa*, *Flavia*, etc., together with two or three species of gorgonias, belonging to the genera *Hymenogorgia*, *Plexaurella* and *Eunicia*.

Turning over the loose corals in the pond, I found a host of interesting things, sea-urchins (*Echinometra Michelini*), crimson starfishes (*Echinaster crassispina* Verrill), together with many odd crabs. There is a curious little crustacean, of which there appears to be more than one species on the coast of Brazil, called the *Tamarú*. I used to be much puzzled when walking near muddy shores when the tide was down, by hearing a sharp clicking sound. The *Tamarús* are the musicians. I suppose the sound to be made in some way by the claws. These *Tamarús* are very abundant, living in the holes in the reefs, and I have more than once, when sailing over a reef, heard their musical click in the water underneath me. There is a whole group of shrimp-like crustaceans, whose hind-body is unprotected by a shell, and which are called hermit-crabs, from their taking up their abode in dead shells. I found one large hermit-crab on this reef, which was occupying a rather large shell on which was seated a sea-anemone. It is a strange companionship which has been observed to exist between other species elsewhere. The reef is not very rich in shells.

One of the men threw the round net successfully over some charming little fishes in the ponds, and we soon had a

large collection of things, which we carried to the edge of the reef. The tide by this time had gone down farther, and the water was low enough on the border of the reef to allow one to wade all over and examine it. The very edge of the reef where the waves washed at low tide is higher than elsewhere, partially owing to a better opportunity being offered for the growth of corals, but also to a luxuriant growth of serpulæ, barnacles, etc. From this line the reef slopes gently down to the edge,* where it drops down perpendicularly into deep water, as at the islands. This border, where the water was of little depth, and where the bottom was never exposed at low tide, may be at times very narrow, or even a hundred feet or more in width. It is a perfect garden of corals. Do you wonder, my reader, that the writer felt a little bit excited as he waded about, up to his waist in water, over these coral beds?

The whole reef is alive. Here is a big head of *Acanthastræa Braziliensis* Verrill. We must have that, so down we bend to tear it away from the reef. A wave goes over our head, but what of that? the prize is secured. We tug away to tear up the fronds of the gorgonias, and toss them over the edge of the reef into a pool of water. Now we fill our arms, never so carefully, with pretty pink rosettes of *Millepora nitida* Verrill, which we are careful about handling, because of their stinging properties. These are safely lodged on the reef, and we wade out once more to the very edge of the reef (never mind the sharks!). Here are beautiful clusters of the pretty *Mussa*, with which Professor Verrill has done the writer the honor of associating his name, that look like great bouquets of whitish pinks. What a pity that we cannot pluck them whole, for they break up and go all to pieces, while the polyps out of water lose all their beauty!

But I shall make this paper too long, if I stop to enumerate all the beautiful things of this garden of the sea; the

* This submerged border is seen in the sketch.

tide is coming in, and we must be in haste. We have yet time, however, for a short walk over the reef.

The tide creeps over the reef. Our specimens are transferred to the deck of the launch, and we put out of our little harbor, with a sigh that our exploration in the Abrolhos waters are ended.

The depth alongside the reef at low water varies much, being in some places but three or four, in others ten feet or more. Just alongside the reef, at least on the inside wherever I have examined it, the bottom consists of a soft, bluish, calcareous mud. The bottom usually slopes rapidly from the reef, and one may at a short distance away in some places find a depth of seventy to eighty feet. Generally the reef is bordered by Chapeirões.

Similar reefs are found a few miles farther south at Corôa Vermelha and the vicinity, but I know of none still farther southward. To the north they occur at intervals with the same characters at Itacolumis, Porto Seguro, Santa Cruz, Bahia, Maceió, and along the coast in the vicinity of Pernambuco and northward. The Rocas, a very dangerous reef lying in the latitude of Fernando de Noronha is a coral reef, and is remarkable for its annular shape, inclosing a space in the centre free from corals.

From the descriptions of the sailors, Corôa Vermelha is a coral island. The only other of any note I have seen is at the mouth of the bay of Santa Cruz. I saw a few mangrove trees growing upon it. A schooner had struck on the reef near by, and being carried over by the waves, had sunk close inside the reef. From the height to which the water reached on the mast, I estimated the height of the reef at thirty feet.

Fortunately we had a pleasant trip home, and late in the afternoon the launch was anchored off the melting-house of the Barra. A few cornet notes brought out some of the inhabitants to welcome the incomprehensible *Naturalista*, who, landing, spent the rest of daylight in examining the

carcasses of some huge whales brought in to land since his departure.

The moon rose full and round, but waned rapidly as she neared the zenith. A fine eclipse took place which was almost total. Crowds gathered on the shore to watch the moon's fading light. The *Americano* ought to be able to explain it. He is applied to. Whereupon, by the light of an antique oil-lamp in a store near by, with a big earthen water-jar to personate the earth, and a smaller one the moon, a lecture on the theory of eclipses was delivered to an appreciative audience, with heaven's blue dome for a chart.

Next day a few hundred weight of whales' bones were added to our freight, and we moved up stream. The tiled roofs and white walls and cocoa palms of Caravellas came in view, Jaco blew his horn, and, in a few moments, with the rattle of the chain from the bow, the Cruise of the "Abrolhos" had ended.

NOBERT'S TEST PLATE AND MODERN MICROSCOPES.

BY CHARLES STODDER.

EVERY possessor of a first-class microscope wishes to know what his instrument is capable of doing. To the practical worker it is a matter of much importance, for when the utmost power of his instrument is exhausted, he will know that it is a waste of time to endeavor to see more. One of the desirable and important properties of a microscope is the power to show or "resolve" very fine lines grouped together, e. g. the striation of the frustules* of the diatomacææ. For the purpose of testing the resolving power of the microscope, the lines ruled on glass by F. A. Nobert, of Barth,

*A frustule (*L. frustum*, a fragment) is one of the fragments into which diatoms separate.